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FOREWORD

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Patricia A. Buhler

Principal Investigator's Signature

Nov. 25, 2000

Date

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INTRODUCTION

The Riparian Woodland Restoration Project (Award No. DAMD17-99-2-9051) is a planting and maintenance plan to restore the wildland habitat of a 7.1-hectare parcel of land in the Lower Dry Creek area of Beale Air Force Base in northern California. The project was initiated in fall 1999, and is expected to be complete in fall 2002. The purpose of this project is to investigate various methodologies of plant establishment and to document their relative efficiencies. The factors under investigation include: plant age, amount of irrigation and level of plant protection during the maintenance period. The experiment has been laid out in a split plot design, with a factorial arrangement of treatments, such that all levels of factors under investigation will occur in all possible combinations. At the end of the three-year cycle, performance will be evaluated by assessing survivorship and plant growth (height and stem caliper).

BODY

The progress made thus far on the Riparian Woodland Restoration Project has been itemized below in the following list, with references to relevant **Tasks** outlined in the approved Statement of Work.

1. Area burned, leveled (as needed); berms in field 1 eliminated (**Task 1.4**)
2. Valves and additional irrigation mainlines installed, permitting irrigation of this parcel independently of Project No. 63154 (**Task 1.5**)
3. Rows marked, irrigation lines laid out in preparation for planting of acorns and seedlings (**Task 1.5**)
4. Acorns gathered, some stored; 500 acorns delivered to CSU, Chico Horticulture Unit for propagation of oak seedlings as per agreement (seedlings to be delivered May 2000) (**Task 1.2**)
5. Acorn-planting sites marked and augered (Dec. 1999) (**Task 1.4**)
6. Approximately 1850 locally-collected acorns planted (Dec. 1999) in 620 planting sites in fields 1 and 7, in randomly-selected rows within blocks of those two fields (Rows 2, 5, 9 and 11 in Field 1, and rows 2, 5, 9, 10, 14, 18 and 21 in Field 7) (Fig. 1, attached). Seedling protectors installed over acorn-planting sites. Three different kinds of seedling protectors were selected, representing three different levels of input: Milk cartons ($.20 each), Tree-pees ($1.75 each) and SuperTubes® ($3.25 each) (cost includes support stake). In each row of planted acorns, ten seedling protectors of each of the three styles were installed. (**Task 1.8**)
7. Emitters installed to deliver irrigation water to each planting site (**Task 1.9**)
8. Approximately 400 nursery-propagated oak seedlings transplanted to 400 planting sites in fields 1 and 7, in randomly-selected rows within blocks in those two fields (Rows 3, 4, 7 and 10 in Field 1, and rows 1, 6, 7, 11, 13, 17 and 20 in Field 7) (Summer 2000, except for Row 6 of Field 7. Planting in that row was delayed due to inaccessibility of that part of the site because of stream relocation activities by the Army Corps of Engineers. Without consulting our contact in Environmental Flight at BAFB, the Corps began using a portion of Field 7 in early summer to get rid of excess water from Best Slough, to the north, using moveable sprinklers in Field 7. This continued through most of the summer, but it actually did not interfere with our activities to a very great extent; it merely prevented us from transplanting one row of seedlings until late summer.) The same

seedling protectors that were used for the acorns were also installed over the oak seedlings. **(Task 1.8)**

9. Emitters installed to deliver water to transplanted oak seedlings at time of transplanting. Either one or two emitters installed for each seedling, in order to deliver either 0.5 or 1.0 gallon of water per hour **(Task 1.9)**
10. Weed control was carried out throughout the season through a combination of mowing, weed-eating, herbicide application and hand weeding. **(Task 1.7)**
11. Plugs of purple needlegrass were produced in spring 2000, but they were not ready for transplanting until May, so the decision was made to maintain the plugs in the CSU, Chico nursery until fall 2000. At that time they will be transplanted to the designated grassland areas between rows 6 and 7, and between rows 15 and 16 in Field 7 (**Fig. 1**). **(Task 1.6)**

Difficulties Encountered

Unexpectedly low emergence of oak seedlings from planted acorns (approximately 5% emergence) was attributed to an extremely heavy rainfall and associated flooding which washed through Fields 7 and 1 on Jan 24, 2000. As a consequence of this flooding, augered holes in which the acorns were planted settled 25 cm or more, and the acorns, which had not yet sprouted, were buried too deeply to permit good germination. Currently, plant stands in those rows planted to acorns is extremely low, and it will be difficult if not impossible to identify statistically significant treatment differences with such low plant numbers. We propose to replant those rows in fall 2000 with acorns collected in fall 2000. The performance of the fall-1999-planted acorns will be tracked separately from that of the fall-2000-planted acorns, but they will all be included in the experiment initially laid out in the Statement of Work. In anticipation of this action, we have collected approximately 1500 – 2000 acorns this fall.

At the time of project initiation, we learned that Blu-X™ seedling protectors were no longer available, so we substituted 48-inch SuperTubes® as one of the three tree-protection treatments. The SuperTubes® are more expensive than TreePees™, and we anticipate that more labor will be involved, at least initially, in hand-weeding inside these tree protectors, so the TreePee™ treatment has now been designated the medium-input treatment, and the SuperTube® treatment is now referred to as the high-input treatment.

Based on the performance of plants in the restoration planting in an adjoining 40 acres, we concluded that weekly irrigation would be detrimental to plant establishment. (While we were not able to state it conclusively, it appeared that superior plant performance had occurred where watering was less frequent, especially for the oaks and coyotebush specimens in Fields 2, 3 and 8, as compared to performance in Fields 5 and 6, where water delivery in the early phases of establishment was more reliable.) Consequently we modified the irrigation treatments to consist of a "high-input" treatment of high water volume (1.0 gal per hr) and a "low-input" treatment of 0.5 gal per hr, but both of those treatments at frequencies of not more than every other week. In the planning phase of a project, it would be good to know whether the larger-volume emitters confer any advantage. Initial cost of the high-volume emitters themselves is no different from that of the low-volume emitters, but volume of water being delivered to the field determines the size of pump needed for a project, so high-volume emitters may require a larger pump size for a large project.

KEY RESEARCH ACCOMPLISHMENTS

- Oak seedlings were established in a 7.1-hectare parcel of land on Beale Air Force Base in the Sacramento Valley of northern California, at a density of approximately 60 plants per hectare. Emergence of seedlings from planted acorns was estimated to be approximately 5%. Survivorship of transplanted oak seedlings was estimated to be approximately 95%.
- Experimental treatments were installed on those plants that were available.

REPORTABLE OUTCOMES

Subsequent to this award, funding was sought for a similar restoration project on the Sacramento River in Tehama County. That project was titled: "Enhancement of Plant Establishment in Restoration Sites". Clean Water Act Funds were channeled through the Bureau of Land Management ($20,000); matching funds for the same project were awarded by California State University's Agricultural Research Initiative ($17,000)

This award was also cited as evidence of scholarly activity on the part of the project director, in applications for four additional funding applications:

1) A project titled "A Photochemical method for Insect Eradication in Post-Harvest Handling of Rice: A Novel Approach", submitted to the evaluation committee for California State University's Agricultural Research Initiative, as well as to matching-funds sources USDA and Farmers Rice Cooperative (total amount requested: $$1,308,804);
2) A project titled "Strawberry Production as Influenced by Preplant Soil Pasteurization vs. Soil Fumigation", also submitted to California State University's Agricultural Research Initiative (amount requested: $95,944.60);
3) A project titled "Systematic Integration of Biotechnology into Agriculture Curriculum", submitted to the USDA Higher Education Challenge Grants Program 2000 (amount requested: $61,343); and
4) A project titled "Research Equipment for Soil Pasteurization Study." submitted to the USDA National Research Initiative Competitive Grants Program (Strengthening Awards Program) (amount requested: $24,944).

Funding has been approved for the first three projects; the fourth one is pending.

The project coordinator, Quentin Colgan, is employed on a part-time basis by this project, and is actively seeking full-time, permanent employment in the area of agricultural education. To this end, he has submitted employment applications with the following school districts, and has cited this project as a source of valuable job experience and training:

1) Northern Humboldt Unified School District, Arcata, CA;
2) Arbuckle Unified School District, Arbuckle, CA
3) Del Norte County Unified School District, Crescent City, CA
4) Hamilton Union High School District, Hamilton City, CA
5) Live Oak Unified School District, Live Oak, CA
6) Butte County Office of Education, Oroville, CA

CONCLUSIONS

Since the project has not yet been completed, conclusions regarding the efficacy of treatments are premature.

REFERENCES

Delwiche, Patricia A. 1999. Valley Oak Savanna / Woodland Unit Plan. Proposal submitted to U.S. Army Medical Research Acquisition Activity, Aug. 1999.

APPENDIX

Fig. 1. Beale Project No. DAMD17-99-2-9051, Fields 1 and 7, planting plan and treatment layout.